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21.3.4 CHEMICAL STANDARDS AND DETECTION LIMITS (REF WQB7)

CIRCULAR WQB-7

MONTANA

NUMERIC WATER QUALITY STANDARDS



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CIRCULAR WQB-7

CIRCULAR WQB-7, Montana Numerical Water Quality Standards, is a compilation of the most recent Standards available for both Surface Waters and Ground Waters. Reference sources used to compile CIRCULAR WQB-7 are the Environmental Protection Agency (EPA) Region VIII's Clean Water Act Section 304(a) Criteria Chart, dated 07/01/1993, and Standards established as drinking water maximum contaminant levels (MCL's). It is anticipated that CIRCULAR WQB-7 will be added to, modified, and/or updated as additional or new information becomes available. Care should be exercised to ensure that the most recent version (by date) is used as a reference.

CIRCULAR WQB-7 is a complex document. Close attention must be paid to the frequent use of 'detailed notes of explanation'. They are used in both the table headings and individual line items, many times, both. Detailed notes of explanation follow the table portion of CIRCULAR WQB-7 and are found in the format of (n) where n is a number.

CIRCULAR WQB-7 uses the more restrictive value of either the 304(a) criteria or the drinking water MCL for Human Health Standards, whenever required, in order to be able to fully protect the concept of 'multi-use' of Montana's waters. For instance, if the human-health Standard for a particular pollutant has been established at 1,200 µg/L (micro-grams per Liter) and the same pollutant has an organoleptic (taste and/or odor) Standard established at 20 µg/L, then CIRCULAR WQB-7 would have the Standard set at the more limiting value of 20 µg/L. In similar manner, whenever both Aquatic Life Standards and Human Health Standards exist for the same analyte, the more restrictive of these values will be used as the numeric Surface Water Quality Standard.

CIRCULAR WQB-7 sets Standards for surface and ground waters. In addition, WQB-7 lists values which are to be used in conjunction with the non-degradation rules ARM 16.20.701 et seq to determine and evaluate degradation. Standards for 'Harmful' parameters will be used as nondegradation criteria for both surface waters and ground waters. For a given pollutant, the Human Health Standard is the same for both surface and ground water but the analysis method differs. Except where noted, the surface water analysis method is always 'total-recoverable' while the analysis method used for ground water will be 'dissolved'.

Special attention should be paid to the pollutants/conditions such as ammonia, hardness, and oxygen as the Standards are set over a range of values, or are computed using a complex formula, or depend upon special circumstances.

Alkalinity, chloride, hardness, sediment, sulfate, and total dissolved solids have 'Narrative Standards' and are referenced back to the Administrative Rules of Montana (ARM) 16.20.633(1) et seq and ARM 16.20.1003 et seq for further details and explanation.

The Standards for fecal coliform, color, dissolved gases, odor, pH, and temperature are dependent upon the water-use classifications as specified in ARM Title 16, Chapter 20 - Water Quality, Sub-Chapter 6, SURFACE WATER QUALITY STANDARDS.

Except where indicated, values are listed as (µg/L). A '---' indicates no Standard or information is unavailable. A '(n)' indicates that an explanation is provided.

Pollutant Element / Chemical Compound or Condition	Aquatic Life Standards (16)		Human Health Standards (17) (19)	Required Reporting Value (19)
	Acute (3)	Chronic (4)		
Alkalinity, total, as CaCO ₃ §§ ---	---	---	---	5,000
Aluminum, pH 6.5 to 9.0 only (9) (6) §§ Al	750	87	---	95.4
Ammonia plus un-ionized ammonia as N §§ --- § Ammonia Anhydrous § Anhydrous Ammonia § Spirit of Hartshorn	(7)(8)	(7)(8)	---	50
Antimony (9) §§ Sb § Antimony Black § Antimony Regulus § C.I. 77050 § Stibium	---	---	14	3.18
Aroclor 1016 §§ PCB 1016 § PCB-1016 § Aroclor 1016 § Chlorodiphenyl (16% Cl) § Polychlorinated Biphenyl (Aroclor 1016)	---	0.014	0.000044	1
Arsenic, inorganic (9) §§ As § Arsenicals § Arsenic-75 § Arsenic Black § Colloidal Arsenic § Grey Arsenic § Metallic Arsenic	360	190	0.018	3.18
Barium (9) §§ Ba	---	---	1,000	5
Benzene §§ --- § Phene § Benzol § Benzolene § Pyrobenzol § Carbon Oil § SHA 109301 § Coal Naphtha § Motor Benzol § Phenyl hydride § Cyclohexatriene § Caswell Number 077 § RCRA Waste Number U019 § EPA Pesticide Chemical Code 008801 § NCI C55276	---	---	1.2	0.5
Beryllium (9) §§ Be § Beryllium-9 § Glucinum § RCRA Waste Number P015	---	---	4.0	1
Cadmium (9) §§ Cd § C.I. 77180 § Colloidal Cadmium	3.9 @ 100 mg/l hardness (12)	1.1 @ 100 mg/l hardness (12)	5	0.1
Chloride §§ ---	860,000	230,000	---	1,000
Chlorine, total residual §§ Cl § Bertholite § Chlorine, molecular § Molecular Chlorine	19	11	---	---
Chromium (9) §§ Cr § Chrome	---	---	100	1
Chromium, trivalent (9) §§ Chromium (III)	1,700 @ 100 mg/l hardness (12)	210 @ 100 mg/l hardness (12)	100	---
Chromium, hexavalent (9) §§ Chromium (VI)	16	11	100	5
Coliform, fecal (13) (18) §§ ---	---	---	---, Surface 1 per 100mL, Ground	1 per 100mL, Surface 1 per 100mL, Ground
Color (13) §§ ---	---	---	---	5 UNITS
Conductance, specific (21) §§ ---	---	---	---	---

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Except where indicated, values are listed as (µg/L). A '---' indicates no Standard or information is unavailable. A '(n)' indicates that an explanation is provided.					
Pollutant Element / Chemical Compound or Condition	Aquatic Life Standards (16)		Human Health Standards (17) (19)	Required Reporting Value (19)	
	Acute (3)	Chronic (4)			
Copper (9) §§ Cu § Allbri Natural Copper § ANAC 110 § Arwood Copper § Bronze Powder § CDA 101 § CDA 102 § CDA 110 § CDA 122 § C.I. 77400 § C.I. Pigment Metal 2 § Copper Bronze § 1721 Gold § Gold Bronze § Kafar Copper § M1 (Copper) § M2 (Copper) § OFHC C _u § Raney Copper	18 @ 100 mg/l hardness (12)	12 @ 100 mg/l hardness (12)	1,000	1	
Cyanide, total §§ --- § Cyanide § Isocyanide § Cyanide Ion § Free Cyanide § Cyanide Anion § Carbon Nitride Ion (CN ⁻¹) § RCRA Waste Number P030 § Cyanide, weak acid dissociable (WAD) § Cyanides, includes soluble salts and complexes	22	5.2	200	5	
Fluoride §§ Flourine § Fluoride § Fluoride ⁽¹⁻⁾ § Perfluoride § Fluoride Ion § Fluorine, Ion § Soluable Fluoride § RCRA Waste Number P056 § Hydrofluoric Acid, Ion(1-)	---	---	4,000	100	
Hardness, total §§ ---	---	---	---	1,000	
Hydrogen Sulfide §§ --- § Stink Damp § Sulfur Hydride § Hydrogen Sulphide § Dihydrogen Sulfide § Hydrosulfuric Acid § Sulfurated Hydrogen § RCRA Waste Number U135 § Dihydrogen Monosulfide § Hydrogen Sulfuric Acid	---	2	---	200	
Iodine (10) §§ I	---	---	4 mrem ede/yr	---	
Iron (9) §§ Fe § Ancor EN 80/150 § Carbonyl Iron § Armco Iron	---	1,000	300	10	
Lead (9) §§ Pb § C.I. 77575 § C.I. Pigment Metal 4 § Glover § Lead Flake § Lead 22 § Omaha § Omaha & Grant § SI § SO	82 @ 100 mg/l hardness (12)	3.2 @ 100 mg/l hardness (12)	15	3.18	
Manganese (9) §§ Mn § Colloidal Manganese § Magnacat § Tronamang	---	---	50	5	
Mercury (9) §§ Hg § Colloidal Mercury § Mercury, Metallic § NCI C60399 § Quick Silver § RCRA Waste Number U151	2.4	0.012	0.14	0.636	
Nickel (9) §§ Ni § C.I. 77775 § Ni 270 § Nickel 270 § Ni 0901-S § Ni 4303T § NP 2 § Raney Alloy § Raney Nickel	1,400 @ 100 mg/l hardness (12)	160 @ 100 mg/l hardness (12)	100	20	
Nitrate (as Nitrogen[N]) §§ NO ₃	(8)	(8)	10,000	10	
Nitrite (as Nitrogen[N]) §§ NO ₂	(8)	(8)	1,000	10	
Nitrate plus nitrite (as Nitrogen[N]) §§ NO ₃ + NO ₂	(8)	(8)	10,000	10	
Odor (13) §§ ---	---	---	---	---	
Oxygen, dissolved (20) §§ O ₂ § Oxygen, Compressed § Oxygen, Refrigerated Liquid	(13) (15)	(15)	---	100	

Except where indicated, values are listed as (µg/L). A '---' indicates no Standard or information is unavailable. A '(n)' indicates that an explanation is provided.

Pollutant Element / Chemical Compound or Condition	Aquatic Life Standards (16)		Human Health Standards (17) (19)	Required Reporting Value (19)
	Acute (3)	Chronic (4)		
pH (13) §§ ---	---	---	---	---
Phenol §§ --- § Baker's P and S Liquid and Ointment § NCI C50124 § Benzenol § Monophenol § Oxybenzene § Phenic Acid § Carbolic Acid § Phenyl Acid § Hydroxybenzene § Hydroxybenzene § Phenyl Alcohol § Phenyl Hydrate § Phenyl Alcohol § Phenyl Hydroxide § Benzene, Hydroxy- § Monohydroxybenzene § RCRA Waste Number U188	---	---	300	10
Phosphorus, inorganic (9) (20) §§ --- § Ortho-phosphorus § phosphorus, Ortho-	(8)	(8)	---	1
Sediment, settleable solids, oils, grease, or floating solids (20) §§ --- § Methylene Blue Active Substances, § Residue, non-filterable, § Residue, non-settleable, § Settleable matter, § Oil & Grease, § Total Organic Carbon, § Hydrocarbons	---	---	---	---
Selenium (9) §§ Se § C.I. 77805 § Colloidal Selenium § Elemental Selenium § Selenium Alloy § Selenium Base § Selenium Dust § Selenium Elemental § Selenium Homopolymer § Selenium Metal Powder, Non-Pyrophoric § Vandex	20	5	50	1
Silver (9) §§ Ag § Argentum § C.I. 77820 § Shell Silver § Silver Atom	4.1 @ 100 mg/l hardness (12)	---	---	3.18
Sulfate §§ SO ₄	---	---	---	1,000
Temperature (13) §§ ---	---	---	---	---
Total dissolved solids (20) §§ TDS § Solids, total dissolved	---	---	---	10,000
Turbidity (13) (20) §§ ---	---	---	---	1 NTU
Uranium, natural §§ U § Uranium Metal, Pyrophoric	---	---	30 picocuries per liter.	---
Zinc (9) §§ Zn § Blue Powder § C.I. 77945 § C.I. Pigment Black 16 § C.I. Pigment Metal 6 § Emanay Zinc Dust § Granular Zinc § Jasad § Merrillite § Pasco § Zinc, Powder or Dust, non-Pyrophoric § Zinc, Powder or Dust, Pyrophoric	120 @ 100 mg/l hardness (12)	110 @ 100mg/l hardness (12)	5,000	10

CIRCULAR WQB-7
DETAILED NOTES OF EXPLANATION

Frequently used Acronyms:

§§ abc...	Name of Primary Synonym as listed in the EPA's data base IRIS.	
§ abc...	Name of Additional Synonyms from various sources including IRIS.	
BCF	Bio-concentration Factor.	
CFR	Code of Federal Regulations.	
EDE/YR	Effective dose equivalent per year.	
E.P.A.	Environmental Protection Agency.	
FPH	A factor in the formula for determining ammonia Standards for Freashwate Aquatic Life.	r
FT	A factor in the formula for determining ammonia Standards for Freashwate Aquatic Life.	r
HM	Halomethanes.	
MDL	Method Detection Limit. The MDL is calculated from the standard deviation of replicate measurements, and is defined as the minimum concentration of a substance that can be identified, measured, and reported with 99 confidence that the analyte concentration is greater than zero.	f %
MREM	Milli Roentgen-Equivalent-Man.	
N/A	Not applicable.	
n.d.	Not determined.	
NTU	Nephelometric Turbidity Unit.	
PAH	Polynuclear Aromatic Hydrocarbons.	
PCB	Polychlorinated Biphenyls.	
TCAP	A factor in the formula for determining ammonia Standards for Freashwate Aquatic Life.	r

- (1) Based on EPA's categories and include parameters determined to be toxic (toxin), carcinogenic (carcinogen), or harmful. Harmful parameters include nutrients, biological agents, and those parameters which cause taste and/or odor effects or physical effects. c e
- (2) Carcinogens: chemicals classified by EPA as carcinogens for an oral route of exposure; Standards are based upon the incremental risk of causing an additional instance of cancer in one million persons. Includes those parameters in classifications A (Human Carcinogen), B1 or B2 (Probable Human Carcinogens), and C (Possible Human Carcinogen). e
- (3) No sample shall exceed these concentrations.
- (4) No four-day (96-hour) or longer period average concentration shall exceed these values. e
- (5) All bioconcentration factors (BCF's) were developed by the EPA as part of these Standards development as mandated by Section 304(a) of the Federal Clean Water Act. Values shown are current as of 07/01/1993. e r
- (6) No sample shall exceed these concentrations.

Standards for metals (except aluminum) in surface water are based upon the analysis of samples following a "total recoverable" digestion procedure (Section 9.4, "Methods for Analysis of Water and Wastes", 1983, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, EPA-600/4-79-020, or equivalent). e g ,

Standards for metals in ground water are based upon the dissolved portion of the sample (after filtration through a 0.45 µm membrane filter, as specified in "Methods for Analysis of Water and Wastes", 1983, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, EPA-600/4-79-020, or equivalent). n d r

For aluminum, both surface and ground water analyses will be based on the dissolved method of analysis. e

(7) Freshwater Aquatic Life Standards for ammonia (mg/l NH_3) are expressed as a function of pH and temperature. The Acute equation and the Chronic equation are as follows:

$$\text{Acute}^1 = 0.52/\text{FT}/\text{FPH}/2 \text{ where } \text{FT} = 10^{0.03(20-\text{TCAP})} \quad \text{if } \text{TCAP} \leq T \leq 30$$

$$= 10^{0.03(20-T)} \quad \text{if } 0 \leq T < \text{TCAP}$$

$$\text{FPH} = 1 \quad \text{if } 8 \leq \text{pH} \leq 9$$

$$= (1 + 10^{7.4-\text{pH}})/1.25 \quad \text{if } 6.5 \leq \text{pH} < 8$$

$$\text{TCAP} = 20^\circ \text{C} \quad \text{if Salmonids or other sensitive cold-water species present.}$$

$$= 25^\circ \text{C} \quad \text{if Salmonids and other sensitive cold-water species absent.}$$

¹ The usual Acute averaging period of one hour is not appropriate if excursions of concentrations to greater than 1.5 times the average occur during the hour; in such cases, a shorter averaging period will be required. To convert these values to mg/l N, multiply by 0.822.

Chronic ² = 0.80/FT/FPH/RATIO where FT and FPH are as above and:

$$\text{RATIO} = 13.5 \quad \text{if } 7.7 \leq \text{pH} \leq 9$$

$$= 20(10^{7.7-\text{pH}}/1 + 10^{7.4-\text{pH}}) \quad \text{if } 6.5 \leq \text{pH} < 7.7$$

$$\text{TCAP} = 15^\circ \text{C} \quad \text{if Salmonids/other sensitive cold-water species present.}$$

$$= 20^\circ \text{C} \quad \text{if Salmonids/other sensitive cold-water species absent.}$$

² Because these formulas are non-linear in pH and temperature, the Standard is the average of separate evaluations of the formulas reflective of the fluctuations of flow, pH, and temperature within the averaging period; it is not appropriate to apply the formula to average pH, temperature and flow. To convert these values to mg/l N, multiply by 0.822.

- (8) A plant nutrient, excessive amounts of which may cause violations of Administrative Rules of Montana (ARM) 16.20.633.(1)(e).
- (9) Approved methods of sample preservation, collection, and analysis for determining compliance with the standards set forth in WQB-7 are found in:
1. 40 CFR Part 136 "Guidelines Establishing Test Procedures For the Analysis Of Pollutants", July 1, 1992, and;
 2. The Environmental Protection Agency's (EPA) Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, dated June 1991, or equivalent, as determined by the Department.
- (10) Radionuclide photon-emitters consisting of either beta or gamma emitters and are classified as carcinogenic. Their associated Standard is based upon a 4 mrede/yr exposure. This exposure is based upon daily ingestion of 2 liters of water. The emitters covered under this Standard are:
- Cesium, radioactive • Iodine, radioactive • Strontium -89 and -90, radioactive • Tritium • Gamma photon emitters
- (11) Chemicals which are not individually classified as carcinogens but which are contained within a class of chemicals with carcinogenicity as the basis for the Standard derivation for that class of chemicals; an individual carcinogenicity assessment for these chemicals is pending.

- (12) Freshwater Aquatic Life Standards for these metals are expressed as a function of total hardness (mg/l, CaCO₃). The values displayed in the chart correspond to a total hardness of 100 mg/l. The hardness relationship is as follows:

	Acute = exp{ma[ln(hardness)]+ba}		Chronic = exp{mc[ln(hardness)]+bc}	
	ma	ba	mc	bc
cadmium	1.128	-3.828	0.7852	-3.490
copper	0.9422	-1.464	0.8545	-1.465
chromium (III)	0.8190	3.688	0.8190	1.561
lead	1.273	-1.460	1.273	-4.705
nickel	0.8460	3.3612	0.8460	1.1645
silver	1.72	-6.52	-----	-----
zinc	0.8473	0.8604	0.8473	0.7614

Note: If the hardness is <25mg/L as CaCO₃, the number 25 will be used in the calculation. If the hardness is greater than or equal to 400 mg/L of CaCO₃, 400 mg/L will be used in the calculation.

- (13) Conditional limitations based upon Water-Use Classifications. See Administrative Rules of Montana (ARM), Title 16, Chapter 20 - Water Quality, Sub-Chapter 6 - SURFACE WATER QUALITY STANDARDS. For groundwater see the Administrative Rules of Montana (ARM) 16.20.633(1) et seq and ARM 16.20.1003 et seq.
- (14) Freshwater Aquatic Life Standard for pentachlorophenol are expressed as a function of pH. Values displayed in the chart correspond to a pH of 7.8 and are recalculated as follows:

$$\text{Acute} = \exp[1.005(\text{pH}) - 4.830]$$

$$\text{Chronic} = \exp[1.005(\text{pH}) - 5.290]$$

- (15) Freshwater Aquatic Life Standard for dissolved oxygen are as follows:

	<u>Standards for Waters Classified</u> <u>A-1, B-1, B-2, C-1, and C-2</u>		<u>Standards for Waters classified</u> <u>B-3, C-3, and I</u>	
	Early Life Stages ^{1,2}	Other Life Stages	Early Life Stages ²	Other Life Stages
30 Day Mean	N/A ³	6.5	N/A ³	5.5
7 Day Mean	9.5 (6.5)	NA	6.0	NA
7 Day Mean Minimum	N/A ³	5.0	N/A ³	4.0
1 Day Minimum ⁴	8.0 (5.0)	4.0	5.0	3.0

¹ These are water column concentrations recommended to achieve the required inter-
grade dissolved oxygen concentrations shown in parentheses. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.

² Includes all embryonic and larval stages and all juvenile forms to 30-day following hatching.

³ N/A (Not Applicable).

⁴ All minima should be considered as instantaneous concentrations to be achieved at all times.

- (16) Aquatic Life Standards apply to surface waters only.
- (17) For surface waters the Standard is the more restrictive of either the Aquatic Life Standard or the Human Health Standard. For groundwaters the standards are based on the dissolved portion (after filtration through a 0.45 micro filter) of the contaminant substance as specified in the EPA publication, EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes." e g
- (18) The Narrative Standards are located in the Administrative Rules of Montana (ARM 16.20.633(1) et seq and ARM 16.20.1003 et seq.)
- (19) The required 'Reporting Value' is the Department's best determination of a level of analysis that should be achieved in routine sampling. It is based on levels actually achieved at both commercial and government laboratories in Montana using accepted methods. 'Reporting Value' is the detection level that must be achieved in reporting ambient or compliance monitoring results to the Department. Higher detection levels may be used if it has been demonstrated that the higher detection levels will be less than 10% of the expected level of the sample. f y d g
- (20) Applicable to surface waters only.
- (21) Applicable to ground waters only.
- (22) Estimated Detection Levels (EDL's) are used as "Trigger Values" whenever MDL's are unavailable. Trigger Values are used to determine whether-or-not a given increase in the concentration of Toxic parameters is significant or non-significant as per the non-degradation rules. e n
- (23) Levels of individual petrochemicals in the water column should not exceed 0.010 of the lowest continuous flow 96-hour LC₅₀ to several important freshwater species, each having a demonstrated high susceptibility to oils and petrochemicals.
- (24) Settling and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. t
- (25) CASRN is an acronym for the American Chemical Society's Chemical Abstracts Service Registry Number. e
- (26) NIOSH RTECS number is a unique number used for accession to the National Institute For Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances.

- (27) SAX number in the format AAA123 is a unique number for identification of materials in the Dangerous Properties of Industrial Materials, authors N. Irving Sax and Richard J. Lewis, publisher Van Nostrand Reinhold.